DOW CORNING ® 93-500
SPACE – GRADE ENCAPSULANT

INFORMATION ABOUT MATERIALS FOR HIGH TECHNOLOGY APPLICATIONS

DESCRIPTION

Dow Corning 93-500 space-grade encapsulate is a transparent, room-temperature-curing, solventless silicone material designed for potting, filling, embedding and encapsulating electronic and other equipment for use in the space environment. It is supplied as a nearly colorless, free flowing, low viscosity fluid.

Features of the uncured encapsulant

Dow Corning 93-500 space-grade encapsulant and its curing agent blend readily, and the low viscosity of the catalyzed material (under 80 poises) aids in the potting and tilling of deep, intricately shaped components. After addition of the curing agent, Dow Corning 93-500 space-grade encapsulant remains workable for about 1 hour at 24 C (75.2 F). The encapsulant cures in unlimited thickness in 24 hours at 25 C (77 F) … even in confined areas … without exotherm. This material is not recommended for use in thin coating of less than 0.010 inch unless confined or covered.

Features of the cured encapsulant

Dow Corning 93-500 space-grade encapsulant has been specially prepared for use in systems that will operate in hard vacuum, but where a high temperature post cure is not feasible. When used as supplied, the encapsulant exhibits extremely low weight loss. It has a total mass loss of less than 0.35% and less than 0.1% collected volatile condensable materials condensed on a 25 C (77 F) collector plate) when exposed for 24 hour at 125 C (275 F) and less than 10^{-6} torr vacuum. Thus chances of contamination of critical surfaces, such as optical systems and exposed electrical contacts are greatly reduced. Dow corning 93-500 space-grade encapsulant can be placed in service immediately following the completion of its room temperature curing schedule. Other features of the cured encapsulant include:

- Transparency - embedded parts can be visually inspected.
- Wide operating temperature - 65 to 200 C (-85 to 392 F).
- Easy reparability - sections of the encapsulant can be cut out for replacement of components; new encapsulant can be poured in place and cured to re-form a tight seal.
- Good physical and electrical stability-retain properties from -65 to 200 C (-85 to 392 F), over a wide range of frequency and humidity.
- Good firmness and flexibility - Shore A scale hardness of approximately 45; elongation of about 100 percent.

- Good damping qualities - low transmission of vibration and shock
- Good environmental protection - low water absorption less than 0.10% after 7 days immersion at 25 C (77 F) ; high resistance to radiation (usable after exposure to 200 megarads).
- Low shrinkage during cure - does not exert pressure on encapsulated or embedded components.

USES

Dow Corning 93-500 space-grade encapsulant is used as an embedding and potting compound to provide resilient environmental protection for modules, relays, power supplies, delay lines, cable connectors, or complete electronic assemblies. It can also be used as an encapsulant for electronic components, circuit boards, and as a solar cell adhesive.
In use the encapsulant assures the protection of electronic circuits and components from temperature
extremes, high humidity, radiation, thermal shock and mechanical vibration. In addition, its inherent
physical and electrical properties make it ideally suited for the harsh environment of space.

ENGINEERING DATA

Operating Temperature Range:
Cured section of Dow Corning 93-500 space-grade encapsulant are useable over a wide temperature range of -65 to 200 C (-85 to 392 F). Short time exposure (less than two hours) at temperatures as high as 300 C (572 F) will not degrade the encapsulant. However, generation of volatile species increases as the temperature is elevated.

When parts are embedded in Dow Corning 93-500 space-grade encapsulant, differences in thermal expansion values between the encapsulant and the embedded parts-and the shape of these parts -may influence temperature limits at which such systems may be used. For this reason, thermal operating limits for embedded components should be accurately determined by laboratory tests before large scale use.

Compatibility
Materials which have been found to inhibit the cure of Dow Corning 93-500 space-grade encapsulant
Include:
Polyvinylchloride, plasticized
Epoxy - amine cured
Dow Corning * 630 protective coating
Dow Corning * 3110,3112 and 3120 RTV silicone rubber cured with Dow Corning RTV catalysts S or F; cured 7 days at room temperature. (Dow Corning 3110, 3112

and 3120 RTV silicone rubbers cured with Dow Corning RTV catalysts S or F at room temperature plus 4 hours at 150 C do not inhibit cure.)
Polysulfide MIL-S-8516
Humiseal ®1B-27 coating
Mystik ®6207 tape
Mystik ®6215 tape
Scotch cellophane tape
Scotch ® 360 tape
Permacel ® Masking Tape
Vinyl electric tape
Pliobond ®adhesive
Latex vacuum tubing
Neoprene Rubber
Buna N Rubber
GRS rubber
Natural Rubber
Viton ® A Rubber
Acid core solder flux
Rosin core solder flux
Sulphur Compounds,
- Thiols
- Sulphices
- Sulphates
- Silphites
- Thioureas

Nitrogen Compounds
- Amines
- Amides
- Imides
- Azides

Each application should be pretested with the product in question.

Corrosion
No corrosion has been observed on common metals-notably copper-when used with Dow Corning 93-500 space-grade encapsulant.

Mixing
Dow Corning® 93-500 curing agent is supplied with the encapsulant. Just prior to use, the two are blended in the ratio of 10parts of encapsulant to 1 part of the curing agent, by weight. Thorough mixing is easy, since both encapsulant and curing agent are supplied as low viscosity fluids. During mixing, care should be taken to minimize entrapment of air. Any entrapped air should be removed before the encapsulant is poured. If the encapsulant is cured in sections less than 1 inch deep, all the entrapped air should escape before the cure is complete. For thick sections and quick de-airing, the use of a vacuum is required. The vacuum should be applied slowly; otherwise,

the material may foam and overflow the container. As a rule, the container should be no more than half full. Vacuum should be held for 3 to 5 minutes after all bubbles have collapsed.

The encapsulant and the curing agent present no handling problems in normal industrial practice, either from the standpoint of skin irritation or accidental ingestion. Eye contact produces a slight temporary discomfort and essentially no irritation.

Varying Curing Agent Concentration
Variations of up to 10 percent in the concentration of curing agent in the Dow Corning 93-500 space-grade encapsulant have little effect upon set-up time or on the properties of the final cured part. Lowering the curing agent concentration by more 10 percent will result in a softer, weaker material which could have higher vacuum weight loss characteristics; increasing the percent will result in over hardening of cured encapsulant and will tend to degrade physical and thermal-vacuum properties.

Preparing containers and components
Containers, molds or components which comes into contact with Dow Corning 93-500 space-grade encapsulant should be clean and dry. Containers or molds which have been used to handle room temperature vulcanizing silicone rubber, organic rubber, or plastics should not be used, since traces of these materials may inhibit the cure or contaminate the encapsulant. Inhibition of cure which results from an incompatible component or substrate can usually be prevented by one of the following methods.

1. Wash the contaminants off with solvent; ultrasonic cleaning has also been found to be effective.
2. Volatilize the contaminants by heating prior to applying the encapsulant.

Applying and Curing
When pouring Dow Corning 93-500 space-grade encapsulant into the unit in which it is to be cured, care should be taken to minimize air entrapment within the system. Where practical, it is suggested that pouring be done under vacuum, particularly if the component being cast has many fine voids. When this technique cannot be the unit should be evacuated after the encapsulant has been poured.

Dow-Corning 93-500 space-grade encapsulation can be satisfactorily cured either exposed to air or completely sealed, and at temperatures ranging from 25 to 150^{o}C (77 to 302^{o}F).

After 24 hours at 25^{o}C (77^{o}F), Dow Corning will have cured sufficiently to allow handling. Full mechanical and electrical strength and optimum weight loss properties, however, will not be achieved for 7 days. Curing time can be appreciably decreased by heating the compound. Suggested quick curing cycles are as follows: 65^{o}C to (149^{o}F) for 4 hours or 100^{o}C (212^{o}F) for 1 hour or 150oC (302oF) for 15

minutes. Relatively massive parts will require additional time in the oven to bring them up to the required temperature.

SHIPPING LIMITATIONS
None.

STORAGE AND SHELF LIFE
When stored in original unopened containers at or below 32°C (77°F), Dow Corning 93-500 space-grade encapsulant has a shelf life of 6 months from the date of shipment.

PACKAGING

Dow Corning 93-500 space-grade encapsulant and its curing agent I separate containers. Net weights for complete packages - encapsulant and curing agent - are:

3.9-oz (110-gm) kit
1.1-lb (.5-kg) kit

USERS PLEASE READ

The information and data contained herein are believed to be accurate and reliable: however, it is the user's responsibility to determine suitability of use. Since Dow Corning cannot know all of the uses to which its products may be put or the conditions of use, it makes no warranties concerning the fitness or suitability of its products for a particular use or purpose.

You should thoroughly test any proposed use of our products and independently conclude satisfactory performance in your application. Likewise, if the manner in which our products are used requires our products are used requires governmental approval or clearance, you must obtain it.

Dow Corning warrants only that its products will meet its specifications. There is no warranty of merchantability or fitness for use nor any other express or implied warranty. The user's exclusive remedy and Dow Corning's sole liability is limited to refund of the purchase price or replacement of any product shown to be otherwise than as warranted. Dow Corning will not be liable for incidental or consequential damages of any kind.

Suggestions of uses should not be taken as inductions to infringe any patents.

DOW CORNING ® 93-500
SPACE-GRADE ENCAPSULANT

Type…….Silicone Rubber
Physical Form
as supplied……..Clear, pourable fluid
as cured……...Firm, flexible rubber
Cure……...Room-temperature curing in approximately 24 hours
Primary Uses……Potting, filling, embedding, and encapsulating electronic equipment used in space environment

TYPICAL PROPERTIES

These values are not intended for use in preparing specifications

As Supplied

Color……Light Straw
Specific Gravity at 25°C(77F)……1.08
Viscosity at 25°C(77F), poises……..80
Pot life at 25 C (77F), with curing agent added, hours……1
Silicone Resin Content, percent……..100

As Cured - 7 Days at 25 C (77 F)

Color……..…Transparent colorless to light straw
Refractive Index……1.4124
Durometer Hardness, Shore A, points…….46
Total Mass Loss, % after 24 hrs at 125 C (275 F) and $\leq 10^{-6}$ torr…….....0.25
Collected Volatile Condensable Materials At 25 C (77 F), percent……..…0.05
Tack free time at 25 C (77F), hours……..…24
Specific Gravity at 25 C (77F)……1.08
Thermal Conductivity, cal per [(cm) (degree C) (sec)]…….3.5×10^{-4}
Linear Coefficient of Expansion, in/in °C-min……300×10^{-5}
Thermal Shock Resistance, from -55 to 155 C (-67 to 312 F) MIL-I-16923 C……Pass 10 cycles
Water Absorption, after 7 Days immersion At 25 C (77 F), percent……Less than 0.01
Brittle Point, degrees……..-65 C (84 F)
Radiation Resistance, Cobalt 60 source……..Still usable after exposure to 200 megarads: hard and brittle after 500 megarads
ASTM D149 Dielectric Strength, t volts/mil……..570
ASTM D 150 Dielectric Constant,
at 100 Hz……..2.75
at 100 KHz……2.73
ASTM 150 Dissipation Factor

at 100 Hz	0.0011
at 100 KHz	0.0013
ASTM D 257 Volume Resistivity, ohm-cm	6.9×10^{12}
ASTM D 412 Tensile Strength, die C, psi	790
ASTM D 412 Elongation, die C, percent	110

* 1part by weight of curing agent to 10 parts by weight of base encapsulant

[t] Tested on specimen 0.062-inch thick using ¼ inch standard ASTM electrodes: 500 volts per second rate of rise

Specification Writers: Please contact Dow Corning Corporation, Midland, Michigan before writing specifications on this product.